

REMARKS

Reconsideration of the present application is respectfully requested.

Initially, for the reasons discussed below, Applicant respectfully requests that the Examiner withdraw the holding of final rejection.

A final rejection is not proper when the Examiner introduces a new ground of rejection that is not necessitated by Applicant's amendment of the claims. (See MPEP 706.07(a) August 2001). In the present Office Action (Dated May 16, 2002), the Examiner has now alleged that Towery discloses hydrogen peroxide as an oxidizing agent. The Examiner has further stated that this new basis for the rejection was necessitated by Applicant's amendments. However, in the first office action on the merits (mailed on Nov. 6, 2001), the Examiner rejected original claim 3 (now canceled) also under 35 U.S.C. 103(a) over Kikuchi in view of Towery. (See Paragraph 11 of the Office Action of Nov. 6, 2001). Original claim 3 also recited using hydrogen peroxide as an oxidizing agent, but the Examiner made no allegation that Towery disclosed hydrogen peroxide in the first Office Action on the merits.

Therefore, the Examiner's present rejection of the claims under Kikuchi in view of Towery in which it is alleged that Towery discloses hydrogen peroxide as an oxidizing agent was not necessitated by the amendment to the claims because such a feature was recited in the original claim set (in now canceled claim 3). Therefore, a clear issue between the Applicant and the Examiner as to what Towery discloses has not yet been developed. (See MPEP 706.07 Aug. 2001). In view of this conclusion, it is respectfully requested that the Examiner withdraw the final rejection as being premature.

In the alternative, Applicant respectfully requests that the Examiner exercise his discretion to give entry and consideration of the present amendment and remarks.

Claims 44, 47 – 65, and 67 – 71 are pending. Claims 45, 46, 66, 72 and 73 have been canceled without prejudice.

Claims 55, 72 and 73 have been rejected under 35 U.S.C. 112, second paragraph as being indefinite. Claims 72 – 73 have been canceled without prejudice and will not be discussed.

Regarding claim 55, the Examiner has alleged that the use of the term “locating” renders claim 55 indefinite. Applicant thanks the Examiner for pointing out this cosmetic defect in claim 55.

Applicant has amended claim 55 to avoid the use of the term “locating”. Therefore, it is respectfully requested that the rejection of claim 55 under 35 U.S.C. 112, second paragraph be withdrawn.

Applicant would like to emphasize that claim 55 was amended for purposes of improving its cosmetic appearance and not due to a substantial reason related to patentability or any other reason that might give rise to estoppel. Therefore, the amendment to claim 55 has not narrowed the scope of this claim within the meaning defined in Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. ___, (2002).

Claims 44 – 56, 58 – 62, 64, and 66 – 69 have been rejected under 35 U.S.C. 103(a) as being unpatentable over the publication entitled “Mechanochemical Polishing of Silicon Carbide Single Crystal with Chromium (III) Oxide Abrasive” and authored by Kikuchi et al. (Kikuchi) in view of Towery. Claims 45, 46 and 66 have been canceled without prejudice and will not be discussed. For the reasons discussed below, claims 44, 47 – 56, 58 – 62, 64 and 67 – 69, as amended, are now in condition for allowance.

Claim 44 has been amended to recite the novel embodiment disclosed on, for example, pgs. 9 – 10 in which a chemical solution is prepared that includes chromium (III) oxide abrasive

grains and hydrogen peroxide water for SIC surface mechanochemical polishing. The oxide on the SIC surface increases polishing efficiency. Further, claim 44 recites the use of a polishing cloth such as, for example, the foamed polyurethane polishing cloth disclosed on pg. 18, line 8. The use of the polishing cloth helps to increase the oxygen concentration at the surface of the wafer, since the polishing cloth holds the solution near the wafer surface.

In comparison, Kikuchi discloses the use of chromium dioxide embedded in a resin disk. However, Kikuchi fails to disclose the use of a chemical solution of chromium dioxide and hydrogen peroxide water.

Towery discloses the use of a slurry that includes an oxidizing agent and an abrasive. The oxidizing agent is used for removing low dielectric material. (See Col. 8, Lines 37 – 40). However, Towery fails to disclose combining chromium dioxide grains and hydrogen peroxide water in a chemical solution.

There is no suggestion or motivation provided in Kikuchi to use an oxidizing agent such as those of Towery to enhance the polishing. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. (See In re Vaeck, 947 F.2d 488 (Fed. Cir. 1991), cited in MPEP 2142, Aug. 2001). The Examiner has alleged that the statement in Kikuchi that “Cr₂O₃ possibly operates catalytically... and enhances the surface oxidation” provides motivation for using an oxidizing agent such as hydrogen peroxide disclosed in Towery. The Examiner’s allegation begs the question. Why would one skilled in the art be motivated to utilize a further oxidizing agent when Kikuchi already discloses that chromium dioxide provides surface oxidation? In actuality, the Examiner’s allegation of motivation

supports Applicant's contention that one skilled in the art would not be motivated to use an oxidizing agent of Towery.

Assuming *arguendo* that one skilled in the art would be motivated to modify Kikuchi to use an oxidizing agent of Towery, such an artisan would certainly not be motivated to utilize hydrogen peroxide as the oxidizing agent. A *prima facie* case of obviousness may be rebutted by showing that the art, in any material respect, teaches away from the claimed invention. (See MPEP 2144.05 III, Aug. 2001). Towery teaches away from the claimed invention because Towery discloses that hydrogen peroxide achieved the worst removal rate (50 Angstroms per minute) in comparison with the other disclosed oxidizing agents such as sodium hypochlorite and ferric nitrate. (See Col. 8, Lines 41 – 50).

Further, there is no suggestion in either Kikuchi or the Towery that the oxygen concentration on the surface of the wafer is increased to promote the formation of an oxide by performing the polishing in the presence of the hydrogen peroxide water.

In summary, Applicant respectfully questions why one skilled in the art would be motivated to modify Kikuchi in view of Towery to provide hydrogen peroxide as an oxidizing agent because Kikuchi already discloses that chromium dioxide achieves satisfactory polishing and provides surface oxidation, and Towery teaches away from using hydrogen peroxide.

In view of the above conclusion, it is respectfully requested that the rejection of claim 44, as amended, be withdrawn.

Claims 47 – 56 and 58 - 60 depend from amended claim 44. Therefore, the rejection of these claims should be withdrawn for the above-mentioned reasons with respect to amended claim 44.

Claim 61 has been amended to recite the novel embodiment discussed above with respect to amended claim 44 in apparatus format. Applicant repeats the arguments made above with respect to amended claim 44 in favor of amended claim 61.

Therefore, the rejection of amended claim 61 should be withdrawn for the above-mentioned reasons with respect to amended claim 44.

Claims 62, 64 and 67 – 69 depend from amended claim 61. Therefore, the rejection of these claims should be withdrawn for the above-mentioned reasons with respect to amended claim 61 (or amended claim 44).

Claims 57, 63 and 65 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Kikuchi in view of Towery and further in view of U.S. Patent No. 6,012,967 to Satake et al. For the reasons discussed below, these claims are in condition for allowance.

Claim 57 depends from amended claim 44. Claims 63 and 65 depend from amended claim 61. Therefore, the rejection of these claims should be withdrawn for the above-mentioned reasons with respect to amended claims 44 and 61.

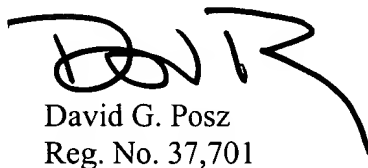
Claim 70 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Kikuchi in view of Towery and further of view of the Background Information in the present application. For the reasons discussed below, claim 70, as amended, is now in condition for allowance.

Claim 70 also recites the novel methodology of polishing a silicon wafer with the chemical solution described above with respect to claim 44. Applicant repeats the arguments made above with respect to claim 44 in favor of amended claim 70.

Therefore, the rejection of amended claim 70 should be withdrawn for the above-mentioned reasons with respect to amended claim 44.

In view of the above amendments and remarks, the present application is now believed to be in condition for allowance. A prompt notice to that effect is respectfully requested.

Respectfully submitted,



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MARKED-UP VERSION OF THE AMENDED CLAIMS

The claims have been amended as follows:

44. (Once Amended) A method for mechanochemical polishing, comprising:
preparing a chemical solution that includes hydrogen peroxide water and abrasive grains
made of chromium (III) oxide; [and]

polishing a surface of a semiconductor wafer by mechanochemical polishing
using the [abrasive grains] chemical solution and a polishing cloth; and

increasing oxygen concentration on the surface of the wafer to promote the
formation of an oxide by performing the polishing in the presence of the hydrogen
peroxide water.

48. (Once Amended) The method according to claim 44, wherein the method
includes dropping the [oxidizing chemical agent] chemical solution onto the surface of
the semiconductor wafer.

49. (Once Amended) The method according to claim 44, wherein the method
includes [performing the polishing in the presence of] adding a solid powder oxidizing
agent to the chemical solution.

52. (Once Amended) The method according to claim 49, wherein the method
includes [dispersing the solid powder in a liquid that is dropped] dropping the chemical

solution, in which the solid powder is dispersed, onto the surface of the semiconductor wafer.

55. (Once Amended) The method according to claim 53, wherein the method includes [locating] placing the solid powder on a member that is moved relatively to and contacts the surface of the semiconductor wafer when the surface is polished.

61. (Once Amended) A mechanochemical polishing apparatus, comprising:
a table on which a semiconductor wafer is held;

a [member] polishing cloth facing the holding table and movable relatively with respect to the semiconductor wafer to polish a surface of the semiconductor wafer using abrasive grains made of chromium (III) oxide; and

[oxidizing agent] supply means for supplying a chemical solution including the abrasive grains and hydrogen peroxide water to the surface of the semiconductor.

62. (Once Amended) The apparatus according to claim 61, wherein said [oxidizing agent] supply means is an injector located above the member for supplying the [hydrogen peroxide water] chemical solution to the surface of the semiconductor.

67. (Once Amended) The apparatus according to claim [66] 61, wherein the polishing cloth is made of one selected from a group consisting of synthetic fibers, glass fibers, natural fibers, synthetic resin and natural resin.

68. (Once Amended) The apparatus according to claim [66] 61, wherein the polishing cloth includes an unwoven type polishing cloth in which complex fabric bodies are impregnated with resin serving as a binding material between fibers or in which a resin layer has a continuously foamed structure.

69. (Once Amended) The apparatus according to claim [66] 61, wherein the polishing cloth is made of formed polyurethane.

70. (Once Amended) A method of manufacturing a semiconductor substrate comprising:

scrubbing a surface of the substrate with a polishing cloth and an abrasive that includes superfine grains of diamond; and

polishing the surface using a chemical solution that includes abrasive grains of chromium (III) oxide [in the presence of] and hydrogen peroxide water to supply oxygen to the surface of the substrate.